DARK ELECTRIC MATTER OBJECTS: HISTORY OF DISCOVERY, MODES OF INTERACTION WITH MATTER, SOME INFERENCES AND PROSPECTS

E. M. DROBYSHEVSKI and M. E. DROBYSHEVSKI

Ioffe Physico-Technical Institute, Russian Academy of Sciences
St.Petersburg, 194021 Russia; E-mail: emdrob@mail.ioffe.ru

Experiments with thin ZnS(Ag) scintillators provide evidence with C.L. > 99.99% for the existence of DArk Electric Matter Objects - daemons (presumably negatively charged Planckian particles with $M \sim 10^{-5}$ g) captured from the Galactic disk into near-Earth, almost circular heliocentric orbits (NEACHOs). Their flux at $V \approx$ 10-15 km/s was found to be as high as $f_{\oplus} > 10^{-7}$ cm^{-2}s^{-1} and vary with $P = 0.5$ y, with maxima in March and September. A daemon flux $f_{\oplus} \sim 10^{-7}$-10^{-6} cm^{-2}s^{-1} is capable of accounting for the Troitsk anomaly in the ^{3}T β-spectrum and suggests its more pronounced manifestation in future KATRIN experiment. In view of the channeling effect on iodine recoil nuclei in the NaI(Tl) crystal, the DAMA/NaI experiment is also apparently detecting a flux of daemons, $f_{\oplus} \sim 6\times10^{-7}$ cm^{-2}s^{-1}, but in this case of those falling with $V =$ 30-50 km/s from strongly elongated, Earth-crossing heliocentric orbits (SEECHOs) oriented in the antapex direction, as a result of which the number of events detected in the 2-6-keV interval varies with $P = 1$ y.

1. Planckian DM objects and possibility of their detection

Our Universe started from Planckian scales, and it appears only reasonable to assume that the larger part of its mass, Dark Matter (DM), remains confined in Planckian objects, elementary black holes whose gravitational radius cannot be smaller than their Compton wavelength. Such objects with $M \sim 10^{-5}$ g and $r_g \sim 10^{-33}$ cm can carry an electric charge of up to $Z\mathrm{e} \approx G^{1/2}M \approx 10\mathrm{e}$. While the properties of similar DArk Electric Matter Objects, *daemons*, were considered by a number of authors [1-8], but the possibility of their detection was perceived skeptically (e.g., [1]).

We started from a notion that negative daemons are nuclear-active particles. Their capture of atomic nuclei should give rise to a release of energy $W \approx 1.8ZZ_nA^{-1/3}$ MeV ($\sim$$10^2$ MeV), with the attendant emission of scintillation-active electrons and nucleons [9]. Becoming confined in the

remainder of the nucleus, the daemon should bring about successive decay of nucleons [10], thus lowering the charge of the remainder to $|Z_n| - |Z| < 0$, which makes it possible for the daemon to capture another nucleus with emission of new particles, etc. We noted also that a negative daemon is capable of catalyzing fusion of light nuclei, up to $Z_n \sim$ 6-9 (an analog of the muon catalysis of deuterons [11]). It should be pointed out that our understanding of the properties and behavior of daemons developed parallel to and in intimate connection with the experiments we were conducting.

Adopting $\sim$0.3 GeV/cm^3 for the DM density in the galactic halo, we arrive at $\sim 5\times10^{-12}$ cm^{-2}s^{-1} for the halo daemon flux intercepted by the Earth. The same applies to the galactic disk DM population with velocity dispersion of 4-30 km/s. The Sun moves relative to the disk objects with $V \approx 20$ km/s (in the direction of the apex, which does not lie in the plane of ecliptic [12]). For such a velocity, the effective cross section of the Sun, amplified by gravitational focusing, exceeds its geometric cross section $\sim 10^3$ times.

In crossing the Sun, daemons suffer slowing down, so that a sizable part of them falls back to move along strongly elongated and rapidly shrinking rosette-shaped trajectories, whose perihelia lie inside the Sun. These daemons settle eventually toward its center to form there a compact daemon kernel, which is capable of accounting for many specific features in solar physics, including generation of non-electron neutrinos [13]. If a daemon propagating along a rosette trajectory crosses the Earth's gravitational sphere of action, the perihelion of this trajectory has a high probability to leave the body of the Sun. This is how daemons enter and build up in stable SEECHOs (until their next encounter with the Earth). Straightforward estimates made in 1996 [14] in the gas-kinetic approximation of the mean free path suggest that the SEECHO daemon flux may reach as high as $f_\oplus \sim 3\times10^{-7}$ cm^{-2}s^{-1} for a velocity of 30-50 km/s.

Recent celestial mechanics calculations [15] showed that SEECHOs crowd primarily in the "shadow" zone, i.e., the zone on the antapex side relative the Sun, because the petals of the rosette trajectories emerging into the apex hemisphere can no longer reach the Earth's orbit as a result of the slowing down the daemons undergo after several crossings of the Sun. Whence it follows that the flux of SEECHO daemons should exhibit a distinct one-year modulation with a maximum some time in June (it is appropriate to point out here that the direction to the apex is slightly different for different galactic disk populations, namely, stars of various classes, interstellar gas etc.; therefore, pinpointing this direction relative to the disk

daemons is a task for the future).

Subsequent crossings by SEECHO objects of the Earth's gravitational sphere result in their gradual transfer to NEACHOs and accumulation there. It is from NEACHOs that daemons fall on the Earth with $V \approx$ 10(11.2)-15 km/s.

2. The history of the daemon discovery

The above considerations, which were continually refined with due account of the building up experience, served as a basis for development of several generations of detectors.

In the very beginning (October 1996 - October 1998), we made an attempt at visualizing daemon-assisted catalysis of the fusion of light nuclei by detecting the sound wave generated by a large energy release along the trajectory (up to $\sim 10^3$ erg/cm [14]). The experiments performed with lithium detectors demonstrated, however, extremely strong damping (along a distance of 2-3 cm) of sound with a characteristic frequency of ∼25 MHz. The experiments in which 45-mm-thick Be plates were used also did not produce promising results, the more so that the unavoidable increase here of the characteristic frequency up to ∼600 MHz would require development of unique methods of detection of such ultrasound. Therefore, both sides of the Be plates were coated with a ∼10-μm-thick layer of ZnS(Ag) scintillator, which could register jets of electrons and up to $\sim 10^4$ ^{18}O nuclei (produced in fusion of Be nuclei) at the points of daemon entry into and exit out of the plates. Each side of the plate was viewed by a FEU-167 PM tube. Two such plates, each of 600 cm^2 area, were assembled into a telescope oriented continuously in the direction of the expected arrival of SEECHO daemons ($\sim 35^o$ leading the Sun). A 700-h exposure accumulated in April-May 1999 did not yield the expected results; indeed, no scintillations with the shape characteristic of the passage of heavy particles (HPSs) and shifted by Δt = 0.5-1.5 μs with respect to one another were observed [16]. An analysis of reasons for this failure led us to the understanding that the catalytic action of daemons should unavoidably be poisoned by their capture of heavy nuclei which are present in our beryllium produced by powder metallurgy (∼0.1 at.% impurities, including Si, Fe etc.). This suggested immediately the possibility of daemon-stimulated nucleon decay [10].

It is this new ideology that underpinned the development in November 1999 of a four-module detector [17]. Each module consisted of a cubic iron-sheet container (0.3-mm-thick Fe sheet coated on both sides with 2 μm Sn layer), 51 cm on a side, covered on top with black paper. In the middle of

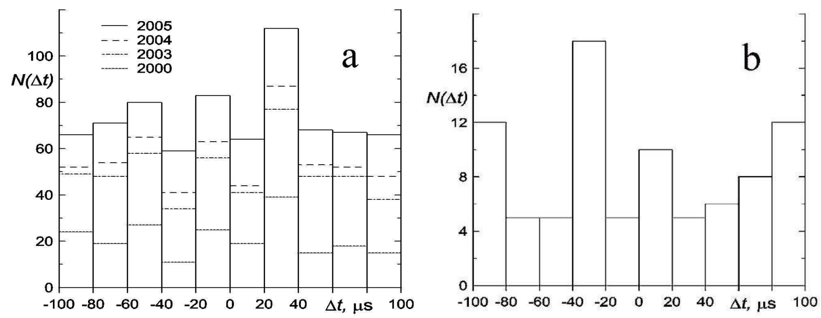


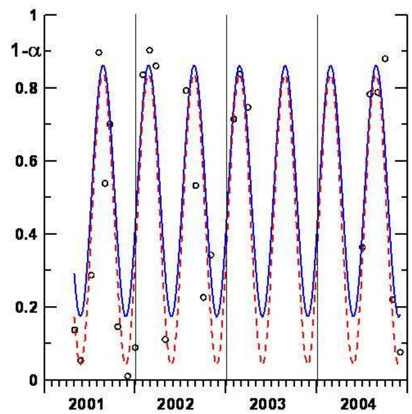
Fig. 1. Distributions $N(\Delta t)$ of pair events on their time shift relative to the upper screen HPSs. (a) The sum of Marches 2000, 2003, 2004, and 2005. The $+30\mu$s maximum exceeds the mean level by 33 events; its significance is 3.63σ (C.L. $>$ 99.97 %) [18]. (b) The underground Baksan experiment [21]. The photo-cathode of the bottom PMT, which is sensitive to daemon passages due to its thick $\sim$1 μm inner Al coating, is screened with Al foil. Observations during September 3-11, 2005; 86 events altogether. Significance of the –30 μs maximum is 2.2σ.

the module, spaced by 7 cm, were fixed two transparent polystyrene plates, 4 mm thick, separated by black paper. Their bottom faces were coated by a $\sim$3.6 mg/cm^2 ZnS(Ag) powder layer. Each plate was viewed on its side by a FEU-167 PM tube. We purposefully made the system sensitivity asymmetric for enhancing the differences in the up/down distributions in the number of time-shifted events. Initially (November-December 1999), all modules were also oriented in the direction of the expected arrival of SEECHO daemons from the Sun (including those crossing the Earth in the evening time).

2.1. *Observation of NEACHO daemons in St. Petersburg*

In January 2000, we discontinued orienting the system; from that time on, the scintillators were always kept horizontally. In February, the $N(\Delta t)$ distribution revealed some features with a hint at statistical significance, so that while previously the detector was switched on for 10-12 h in the daytime, starting with March 1, 2000, it was operated on the round-the-clock basis.

Figure 1a displays $N(\Delta t)$ distributions with HPSs on the top PM tube obtained in the March experiments in 2000, 2003, 2004, and 2005 [18]. The peak at $20 < \Delta t < 40$ μs stands out with a 99.97% confidence. Accepting 29 cm as a base distance from the top ZnS(Ag) layer to the bottom lid of the container (see also Sec. 2.2 below), we arrive at a velocity of 10-15 km/s,



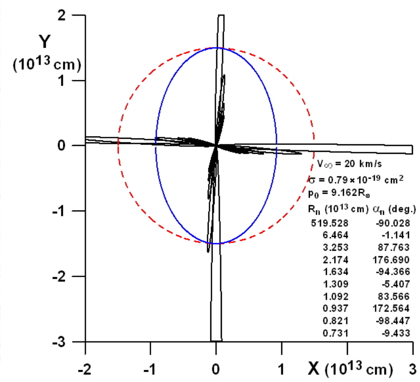


Fig. 2. Seasonal variation of 1 - α, the extent to which the distribution $N(\Delta t)$ (at –100 $< \Delta t < +100$ μs) deviates from the constant level produced by background events. (- - - -) Weights of all the points are equal, the correlation coefficient of the sine curve (P = 0.5 yr) with the points is r = 0.87, its C.L. > 99.9%. (——) Weights of the points are proportional to 1 - α; r = 0.73, its C.L. = 99.3%.

Fig. 3. An example of multi-loop (cross-like) trajectory of an object being braked by the Solar matter at repeated passages through the Sun (its center is at X = 0, Y = 0) [15]. Object of 3×10^{-5} g mass and cross-section $\sigma = 0.79\times10^{-19}$ cm^{2}falls from infinity (X = -∞; V_∞ = 20 km/s) with an impact parameter p_0 = Y(-∞) = 9.162R$_\odot$. The figure plane contains the apex direction and a normal to it lying in the ecliptic plane. An ellipse with the semi-major axis of 1 AU is the Earth's orbit projection; the dotted circle of 1 AU radius is given as a scale for the reader's orientation.

a figure characteristic of objects falling from NEACHOs [17-19]. Assuming $\Delta t \approx 30$ μs to be the time taken up by "digestion" of a Zn nucleus captured in the ZnS(Ag) layer, we come to $\Delta\tau_{ex} \sim 10^{-6}$ s for the time of daemon-stimulated decay of a nucleon (proton or neutron) [19]. For such a value of $\Delta\tau_{ex}$, the dimensions of our detector make it insensitive to the passage of daemons with $V > 30$ km/s, even if they capture S nuclei in passing through the ZnS(Ag) layer.

After a full year of observations and testing of the equipment, we came to the conclusion that the NEACHO flux varies with $P = 0.5$ y, with maxima in March and September (Fig. 2) [20]. This correlates well with our recent calculations of the capture of galactic disk daemons crossing the Sun. As the Sun moves in the apex direction relative to the daemon population of the galactic disk, daemons with an impact parameter of $\approx 9.2 R_\odot$ in the plane that contains the direction to the apex and is tilted at the minimum angle to the plane of ecliptic, cross the Sun with the corresponding slowing down and

become captured into distinctive cross-shaped rosette trajectories (Fig. 3). Their petals, which are normal to the direction to the apex, cross *repeatedly* the Earth's orbit close (*sic*!) to the equinox zones, so that the daemons moving along them can eventually transfer to SEECHOs and, subsequently, to NEACHOs with a probability which is the highest compared with the other possible scenarios. It is these NEACHO daemons that are detected in March and September. Defining the force that slows down the daemon in the Sun by $\sigma\rho V^2$ (ρ is the density of solar material), observation of the maximum NEACHO daemon flux in these months (together with the maximum registration of SEECHOs by DAMA/NaI in June, see Sec. 4) yields for the daemon slowing-down cross section $\sigma \approx 1\times10^{-19}$ cm^2 [15].

2.2. *Underground experiments in Baksan with a daemon-sensitive PM tube*

Experiments performed with FEU-167 PM tubes (photocathode ⌀100 mm, the bulb photocathode section ⌀125 mm) of different manufacturers (Svetlana in St. Petersburg and Ekran in Novosibirsk) showed that tubes with a thicker Al coating ($\sim$1 μm rather than $\sim$0.1 μm as specified) of the inner surface of the bulb photocathode section turn out to be sensitive to the passage of daemons with $V \sim 10$ km/s [18]. This is easy to understand because (*i*) the path length of a complex with Z = -1 to capture of an Al nucleus is $\sim$1 μm, and capture of a nucleus in the metal culminates in emission of many refilling electrons, and (*ii*) passage of the complex, which consists of the daemon plus the remainder of the nucleus captured previously and now being digested, through 4-5 cm of vacuum inside the PM tube, is highly probable to give rise to the appearance and increase of the negative charge of the complex, because in vacuum this charge is not balanced by the positive charge of the nuclei captured for Z = -1 in a path of 1-5 mm through air.

The module, in which only the top scintillator was left and the role of the bottom sensor was played by a FEU-167 with a thick inner Al coating whose photocathode was screened by aluminized Lavsan film, was first tried in the Baksan underground laboratory in September 2005 [21]. To reduce the Rn background, the detector was flushed by liquid N_2 vapor.

The experiment revealed a $\sim$hundredfold increase in detector sensitivity per unit area; indeed, the measured daemon flux with V = 10-15 km/s was as high as $\sim10^{-7}$ cm^{-2}s^{-1}, and it propagated from the interior of the Earth upward, with the maximum in the $N(\Delta t)$ distribution observed for -40 < Δt < -20 μs (Fig. 1b). The underground measurements conducted

in March 2006 (but without nitrogen flushing) revealed a standard peak at $20 < \Delta t < 40$ μs. This substantiated our choice of 29 cm between the top scintillator and the bottom lid of the module as the base distance (Sec. 2.1).

These results find a ready explanation if we assume that daemons build up in NEACHOs external to the Earth's orbit and, touching it on the outside, catch up with the Earth close to the equinoxes (actually, one to two weeks before that). This buildup in the external NEACHOs appears only natural, because in order for an object to be ejected out of the Earth's orbit its velocity has to be increased by $\Delta V \geq 12.3$ km/s, whereas a single interaction with the Earth produces $\Delta V \leq 11.2$ km/s.

It thus follows that it is desirable to perform synchronous measurements in the Northern and Southern hemispheres; in the Southern hemisphere, in March the primary daemon flux will pass from bottom upward, and in September, from top downward.

3. NEACHO & GESCO daemons and the Troitsk anomaly in ^{3}T β-spectrum

Attempts at deriving the electron antineutrino mass from the end-point of the ^{3}T β-spectrum (E_0 = 18574-18590 eV) revealed the presence near the end-point (at $E_0 - E \approx 5$ eV) of a step with an amplitude ∼1-3 mHz, which appears and varies slightly in position with $P = 0.5$ y. This step was observed in the Troitsk experiment making use of an extended gaseous-tritium source of total horizontal area 0.35 m^2 (dia. 5 cm, 3 m long plus ∼4 m-long channel leading to the spectrometer) [22]. No step is observed in Mainz experiments with a well devised solid tritium source.

A significant feature of the gas source, as we see it, is the use of superconducting windings of Nb, $NbTi_2$ and Nb_3Sn alloys needed to create the magnetic field channeling the β electrons. Daemons crossing the windings capture Nb-containing atomic clusters and carry them across the gas source channel. Excitation of these clusters by nuclear-active daemons may conceivably bring about ejection of the inner K electron of niobium (its binding energy E_k = 18990 eV), with a resultant emission of niobium Auger electrons, in particular, of a very compact group of five lines (18566, 18568, 18569, 18570 and 18572 eV), which are close to E_0. The half-year periodicity and the phase of appearance of the step are clearly related with the variation of the low-energy NEACHO daemon flux (and the subsequent flux of objects captured from NEACHOs to GESCOs, geocentric Earth-surface crossing orbits). Adding the velocity of 10-15 km/s to that of Auger

electrons accounts for the dispersion in their energy $\Delta E \approx 5$ eV [23].

Note that fine details in the emission of Nb K electrons from a cluster containing Nb atoms remain unclear and require further consideration. The mechanism involved would be easier to understand if the daemon carrying 9, rather than 10, electronic charges would capture Sn nuclei in the windings ($Z_{Sn} = 50$). In these conditions, the positive charge of the daemon/Sn complex would be exactly equal to that of the Nb nucleus ($Z_{Nb} = 41$). Shakeup of the electronic shells of such a complex, be it as a result of transitions of the Sn nucleus to lower-lying Rydberg levels in the daemon field (they lie within the electronic shells) or as a result of daemon-assisted catalysis of predominantly neutrons' decays in the Sn nucleus (see Sec. 5), would obviously give rise to emission of Auger electrons typical of Nb.

Even if only a third of the daemon-stimulated nucleon decays separated in time by $\sim 10^{-6}$ s in the cluster nuclei are accompanied by emission of Auger electrons in the above-mentioned lines, the observed step amplitude should be reached for $f_{\oplus} \sim 10^{-7}$-10^{-6} cm^{-2}s^{-1}. It may be predicted that the KATRIN version with a gaseous T_2 source (and Nb-Sn containing windings) will reveal a still stronger "Troitsk anomaly".

4. SEECHO daemons and the DAMA/NaI experiment

There are grounds to believe that the one-year modulation of the number of scintillation signals at the 0.04 cpd/kg/keV level observed at a C.L. $= 6.3\sigma$ in the DAMA/NaI experiment in Gran Sasso [24] can likewise be accounted for by daemons rather than by WIMPs as surmised by the authors.

This conclusion is argued persuasively for by the fact that the results obtained in DAMA/NaI are not reproduced in other experiments designed for detection of WIMPs with detectors of other types, although the sensitivity of the latter sometimes even exceeds noticeably that of the DAMA/NaI. To account for this, one is forced to devise rather exotic WIMPs [25].

Interestingly, the one-year modulation is observed only within a narrow range of scintillation amplitudes in NaI(Tl), which correspond to electron energies of 2-6 keV. But these are exactly the energies of the iodine recoils knocked out elastically by SEECHO daemons which fall on the Earth with $V = 30$-50 km/s. The SEECHO flux reaches a maximum sometime in early June (see Sec. 1), which likewise conforms to the DAMA/NaI data.

At first glance, it might seem that the coincidence of the iodine recoil energies E_r with the observed energy of scintillations produced by 2-6-keV electrons is at odds with neutron beam calibrations which yield for $E_r >$ 10 keV of iodine a quenching factor $q < 10\%$ (q is the ratio of scintillation

signal intensities due to ions and electrons of equal energies). Taking into account ion channeling along some crystallographic directions changes the situation, however, because such ions impart nearly all of their energy to valence electrons of the crystal, so that for them $q \to 1$. The channeling probability grows with decreasing E_r, so that for the iodine ion with $E_r =$ 4 keV emitted in an arbitrary direction it is $\eta \approx 20\%$. Thus, the efficiency of registration of 4-keV iodine ions by a NaI(Tl) crystal for $q = 1$ should be ≈20% [26].

Whence it follows that for producing the observed number of 2-6 keV events at the 0.04 cpd/kg/keV level in the 96-kg NaI(Tl) detector with an effective area of ≈1500 cm^2 one would have to assume a SEECHO daemon flux of about $0.04{\times}96{\times}4/86400{\times}1500{\times}\eta = 6{\times}10^{-7}$ cm^{-2}s^{-1} [26]. Obviously enough, a number of attendant points still remain unclear, for instance, those associated with the mechanisms involved in the elastic knocking out of ions by daemons carrying remainders of previously captured nuclei, with a single-hit criterion application, the case where one takes into account events that happened in one out of the nine crystals in the DAMA/NaI experiment only, and so on. Let us hope that LIBRA experiment will provide information capable of shedding light on the situation.

5. Attempts to reveal the daemon-stimulated proton decay

Besides the existence itself of daemons, another basic assumption underpinning our experiment was gradual decomposition of a nucleus captured by the negative daemon residing inside it. We believed that the decomposition involved successive daemon-stimulated proton decays. The time taken up by a daemon-containing Zn nucleus to cross our detector (≈30 μs) limits the mean proton decay time to $\Delta\tau_{ex} \sim 1$ μs (Sec. 2.1).

To detect such a series of successive events, we assembled a detector of 4.3-cm-thick CsI(Tl) crystals of 560 cm^2 total area. We hoped that for $f_\oplus \sim 10^{-7}$ cm^{-2}s^{-1} we would observe once every 5 h a trail of scintillations spaced, on the average, by about ∼1 μs. Adopting a velocity V = 10-15 km/s, we would observe 3 to 4 such scintillations.

Decay of a proton should release an energy of 938 MeV. If the proton decomposes into π^+ and π^0 mesons, they will leave only 100 MeV in a 4.3-cm-thick CsI crystal.

However, at the threshold level of about 50 MeV, we did not observe triple events during weeks!

We thus come to a tentative conclusion that the daemon, a negatively charged Planckian black hole, decomposes the captured nucleus in a some-

what different way. It would be difficult to add something definite on this point at this time. One cannot exclude the possibility, for instance, that a nucleus decomposes by consecutive capture by the daemon of electrically neutral neutrons (by "winding" them on its gravitational horizon, as it were) accompanied by emission of non-detectable gravitons etc. In these conditions, the nucleus would preserve for a certain time a constant (the original) number of protons and its positive charge. The neutron-deficient nuclear remainder would then get rid of the large proton excess by rare (once every few tens of μs) fission events and/or practically simultaneous ejection of products of a new proton fusion (α particles and so on), a process similar to the one occurring in daemon-assisted catalysis of many ($\sim$10) protons in the Sun considered by us elsewhere [27]. The scenario of consecutive daemon-assisted decay of neutrons in a nucleus is argued for possibly by the multiple emission of Auger electrons by the daemon/captured Sn nucleus complex at $Z = 41 = constant$ (see Sec. 3). The daemon itself also may free itself, but much more rarely, of the neutron matter wound on it by flash-evaporating it in the form of hard radiation, to regain its original Planckian mass.

6. Concluding remarks and future prospects

The daemon approach to the nature of DM which we are developing has turned out to be valid, self-consistent and fruitful. Fairly simple experiments not only substantiate the existence of daemons (by now, with a C.L. $>$ 99.99%) but suggest possible directions in which the daemon paradigm can be extended (the need of taking into account the Sun's motion relative to the galactic disk population, daemon-stimulated nucleon decay etc.).

It is essential that the existence of daemons and their buildup in the Solar system in Earth-crossing orbits of different types are argued for not only by our experiments but by the DAMA/NaI project as well. By the way, it becomes now clear why its results are not reproduced in other experiments aimed at detection of WIMPs, as well as that the unavoidable effect of channeling of low-energy iodine ions ($<$10 keV) should play a substantial part in interpretation of the DAMA/NaI results. All the features of the Troitsk anomaly in the tail of the ^{3}T β-spectrum, whose existence was already being questioned by the very people who had discovered it because of its appearing to be impossible to explain, also find ready interpretation in terms of the daemon paradigm (we have in mind the amplitude and width of the step, the half-year periodicity and the phase of its appearance).

The agreement between the ground-level daemon fluxes estimated theo-

retically in 1996 ($\sim 3\times10^{-7}$ cm^{-2}s^{-1} [14]), measured by us experimentally in St. Petersburg and Baksan ($>10^{-7}$ cm^{-2}s^{-1}, 2005 [18,21]), derived from the Troitsk anomaly (10^{-7}-10^{-6} cm^{-2}s^{-1}, 2000 [23]), and following from DAMA/NaI studies ($\sim 6\times10^{-7}$ cm^{-2}s^{-1}, 2003 [26]) is truly remarkable. Celestial mechanics calculations based on our and DAMA/NaI figures have yielded the cross section of daemon braking by solar matter of 10^{-19} cm^2.

Measurements of the direction of propagation of the primary daemon flux suggest daemon buildup in NEACHOs external to the Earth's orbit. It would thus be reasonable to carry out synchronous studies of the March and September fluxes in the Northern and Southern hemispheres. In the Northern hemisphere, in March, the primary daemon flux goes from above downward, while in September, as follows from the Baksan measurements, it passes upward, whereas in the Southern hemisphere the daemons should move in opposite directions relative to the observer.

The conclusions that can be drawn from the daemon paradigm concerning the existence of daemon kernels in the Earth and in the Sun permit us to understand or explain in a new way many geo- and heliophysical observations. The crowding of daemons toward the Galactic center clarifies the reason for the observed appearance of positrons there as a product of daemon-assisted catalysis of proton decay and/or fusion [27-28]. The same may apply to generation of the excess GeV radiation (see Sec. 5).

We have suddenly and completely unexpectedly found ourselves at the threshold of Planckian physics and painfully far away from an adequate understanding of the properties of daemons and of their interaction with matter. It appears therefore only natural that many of the above considerations may turn out in need of further refinement and critical analysis.

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